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DATA ANALYSIS METHOD OF MULTIVARIAT USING STRUCTURAL EQUATION MODELLING (SEM)

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ABSTRACT

On research involving complex variables, data analysis method often used is multivariat method. Generally, multivariat analysis methods can be divided into inpendence methods and interpendence method using Structural Equation Modelling (SEM) tools with some of models (one step, two step and two step into one step). To ensure the validity of the information produced, we use multivariat analysis method and requires knowledge of technical basic assumptions selected and scale of measurement used at the time of data collection. This paper provides explanation of the multivariat analysis methods that includes objectives, basic assumptions, and data types that must be fulfilled in each method.

Keywords : data analysis and processing, multivariate analysis, dependence methods, interdepence methods, Structural Equation Modelling (SEM).

INTRODUCTION

In conducting the research, the stages of data analysis has an important role for discovering information from observations that have been done (Sekaran, 2003; Neuman, 1994; Aaker et al., 1995). In the researches involving the complex variable, one of analysis methods often used is multivariat analysis method. To get accurate and valid information, selection of multivariat analysis method must consider the purpose of research done, the basic assumption of multivariat analysis methods will be selected, and the scale of measurement used at the time of data collection.

Generally, the data can be grouped into two categories, namely data metric (quantitative) and nonmetrik (qualitative) (Hair et al., 2006). Furthermore, the scale of measurement can be divided into four groups: (1) nominal scale, (2) Ordinal scale, (3) interval scale, and (4) ratio scale (Sekaran, 2003). Metric data is measured with interval or ratio scale, while nonmetrik data is measured using nominal or ordinal scale (Singgih, 2002).

CLASSIFICATION OF ANALYSIS TECHNIQUES OF MULTIVARIAT DATA

Dillon and Goldstein (1984) defined multivariat analysis as: All statistical methods to analyze some of measurements (variables) in every object in one or more samples simultaneously.

Based on the definition, each analysis method that involves more than two variables simultaneously can be considered as multivariat analysis.

Generally, multivariat analysis methods can be devided into two groups, namely :

1. Dependence Methods : Multivariat method in which there is a variable or set of dependent variables and other variables as free variables (independent variables).
2. Interdependence Methods: Multivariat method in which all the variables analyzed simultaneously, there is no variable defined freely or dependently.

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Structural Equation Modeling (SEM)

Structural equation modeling is a general definition provided in the multivariat analysis method that has characteristics as follows:

1. Perform estimation of dependent relationships related to one another.
2. Have the ability to present concepts that are not observed directly.

The main difference of modeling method, structural equation using different relationship/equation for each dependent and structural equation of the model created, are as follows:

$X1 = f(X) + Z5$

Marketing Diffusivity = $\beta 1$ Business Policy + Z5

$X1.1 = f\{f(X1)\} + Z1$

Product = f {f (Marketing Diffusivity)} + Z1

$X1.2 = f\{f(X1)\} + Z2$

Price = f {f (Marketing Diffusivity)} + Z2

$X1.3 = f\{f(X1)\} + Z3$

Distribution = f {f (Marketing Diffusivity)} + Z3

$X1.4 = f\{f(X1)\} + Z4$

Promotion = f {f (Marketing Diffusivity)} + Z4

$Y1 = f\{f(X)\} + Z6$

Consumer Behaviour = f {f (Business Policy)} + Z6

$Y2 = f\{f(Y1)\} + Z7$

Purchasing Decision = f {f (Consumer Behaviour)} + Z7

$Y3 = f\{f(Y2)\} + Z8$

Marketing Performance = f {f (Purchasing Decision)} + Z8

$Y4 = f\{f(Y3)\} + Z9$

Compete Sustainable Excellence Continuous Competing Excellence = f {f (Marketing Performance)} + Z9

Equation above is the conceptual framework model of two step model (figure 2).

Techniques that can be used to form the model of structural equation namely kovariansi analysis, confirmative factor analysis, LISREL, and complex regression analysis. The basic assumptions that must be acquired of course adapted to the analytical techniques used. Hair et al. (2006) explains that in general there are seven stages in the use of structural equation modeling techniques.

Modeling Stages of SEM

Basically, a complete modeling of SEM consists of measurement model and Structural Model. Measurement model is intended to confirm a dimension or factor based on empirical indicators. Structural model is a model regarding structure of relationships that explain causality of factors. When the researchers decided to use SEM Tool, they have to create conceptual framework completely so that problems can be resolved completely, because the tool is able to perform processing model of one step, two step, and two step into one step.

There are still a lot of researchers decide to use SEM Tool, but the conceptual framework is not complete, so the settlement of the problem is not complete, and even researchers who have only one endogen variable. If the conceptual framework that is used like that, the tool used better use SPSS.

To create a modeling completely, the following steps need to be done:

1. Development of model based on theory
2. Development of flow diagram to show relationship of causality.
3. Conversion of flow diagram into a set of structural equation and specification of measurement model.
4. Selection of input metrics and estimation technique of the model
5. Assessment of problem identification.
6. Evaluation of model / Goodnes of fit
7. Interpretation and model modification.

For more details, the above steps can be seen in the guidelines and SEM application (Minto, 2009).

In the SEM Modeling, the researchers will work with the "construct" or "factor", is the concepts has theoretical bases adequately to describe the various relationships that started from the path diagram, measuarement model, structural model. If the model is less good, then the researchers can make modifications such as in the following:

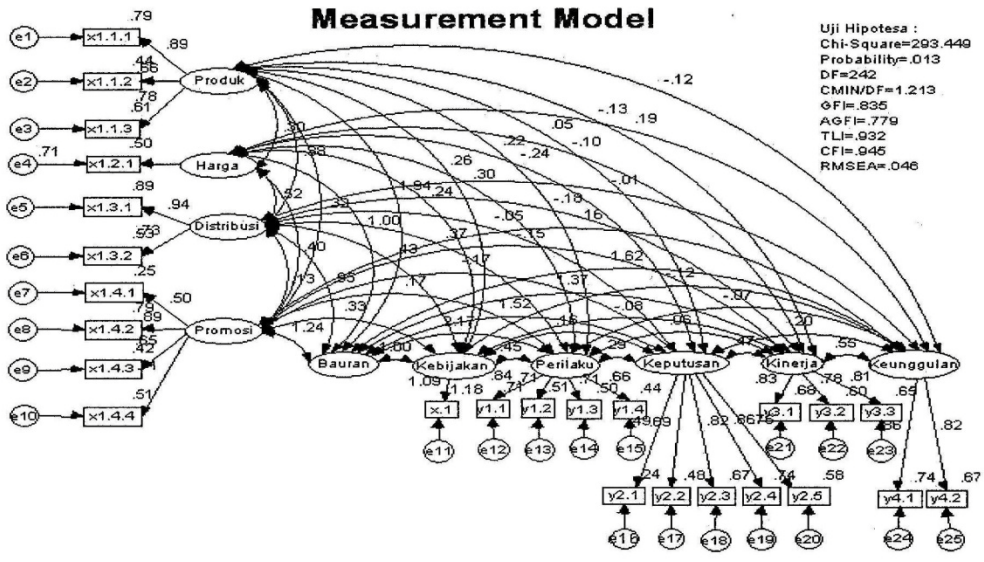

Figure 1 Measurement Model Two Step

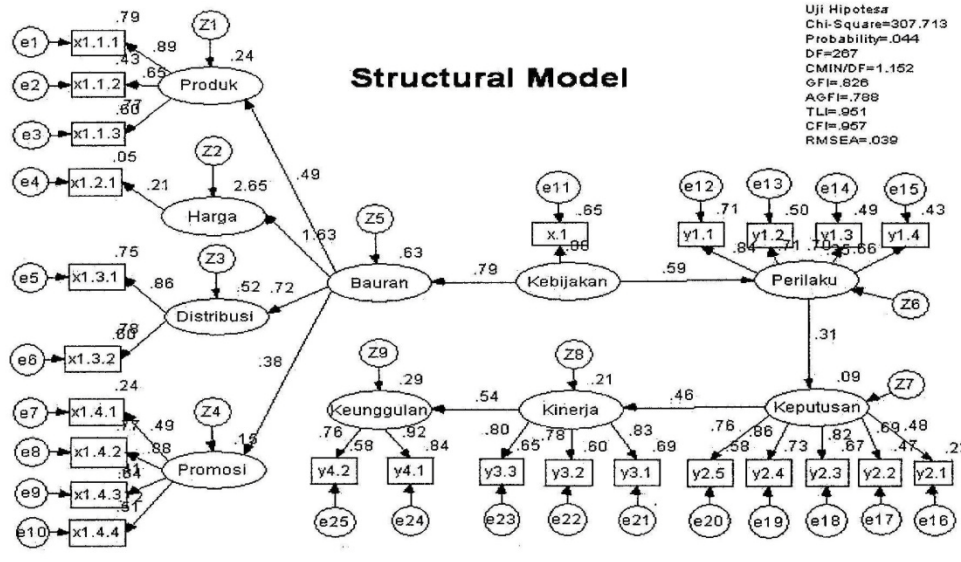

Figure 2 Model two step Guidelines dan SEM Application by Minto Waluyo, 2009

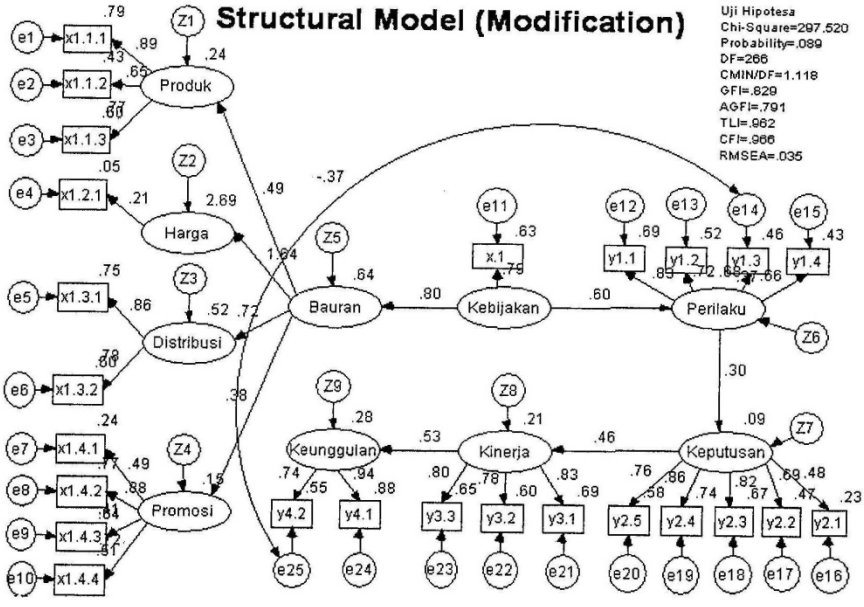

Figure 3 Model two step modified
Guidelines dan SEM Application by Minto Waluyo, 2009

dification Indices

Covariances:

	M.I.	Par Change
Z3 <----------> Z4	5.273	-0.169
e3 <----------> Z8	4.825	-0.083
e15 <----------> Z4	6.139	0.113
e25 <----------> Z6	4.041	-0.047
e25 <----------> Z2	4.157	0.107
e20 <----------> e9	5.753	-0.106
e19 <----------> e10	5.031	-0.055
e19 <----------> e25	8.205	0.064
e22 <----------> Z2	5.117	0.111
e23 <----------> Z7	4.477	0.088
e17 <----------> e19	4.488	-0.051
e16 <----------> Z4	4.281	-0.114
e12 <----------> Z4	5.100	-0.105
e13 <----------> e24	5.825	-0.095
e13 <----------> e25	5.170	0.085
e14 <----------> e25	**9.345**	-0.122
e8 <----------> Z3	4.617	-0.120
e5 <----------> Z7	5.348	-0.121
e5 <----------> Z4	4.080	-0.128
e6 <----------> Z7	4.353	0.114
e6 <----------> e15	6.622	-0.117

12,

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To get a good model, it should be modified. To find the MI, we can relate between e14 and e25, then there will be a decrement of chi-square value. The result can be seen in the figure 3. In this article also presented a model one step and two step model so one step, and its image model.

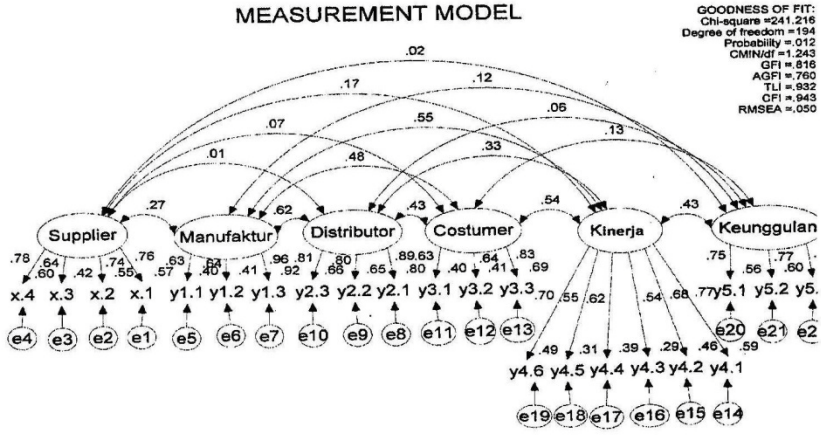

Figure 4 Measurement Model One Step

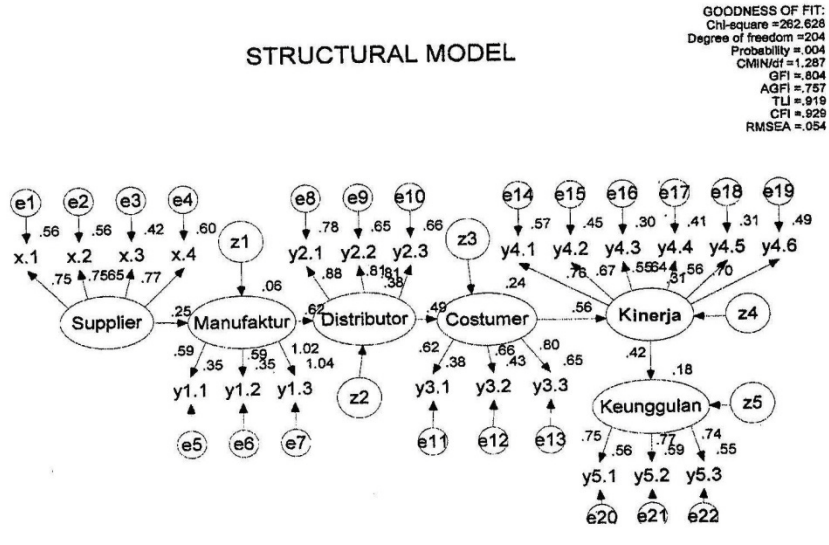

Figure 5 Structural Model One Step

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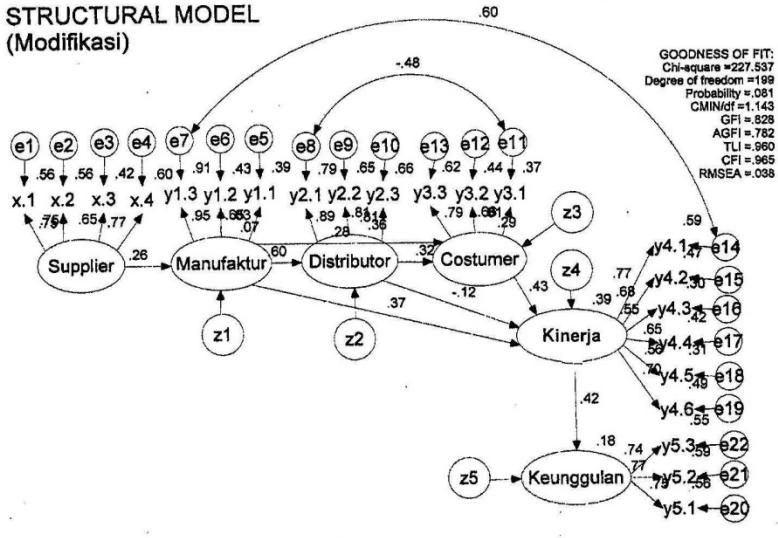

Figure 6 Model One Step modified

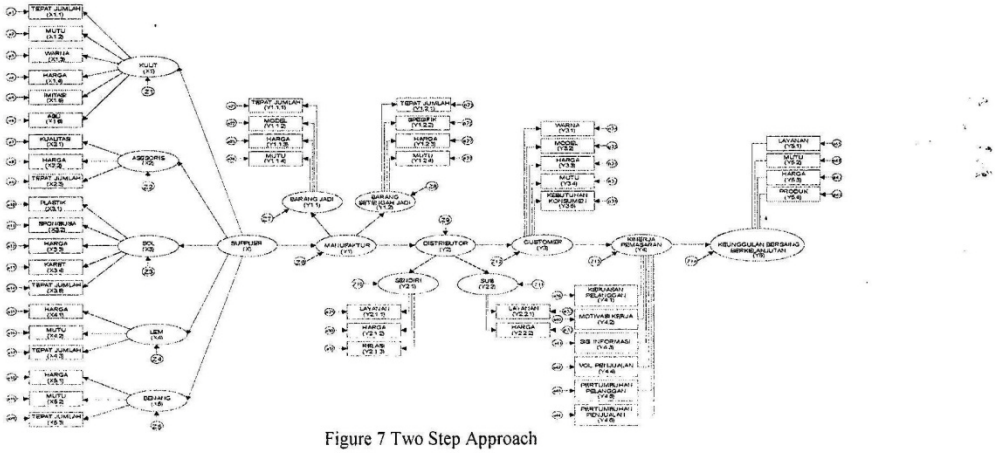

Figure 7 Two Step Approach

Model of figure 8 can not be estimated, there is a warning on monitor with message X1 until X_5, Y_{11}, Y_{12}, Y_{21} and Y_{22} can not be estimated. We have to change model from two step into one step.

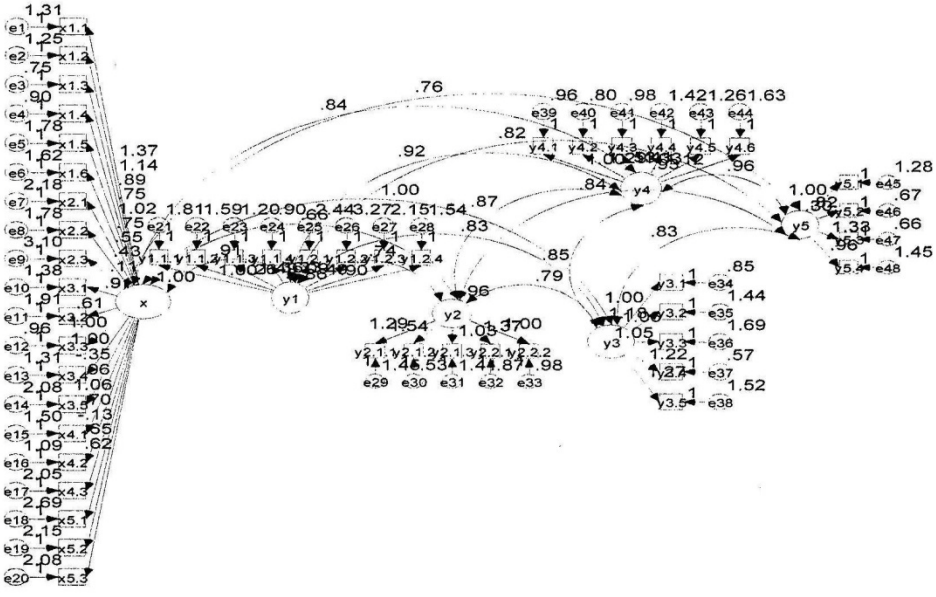

Figure 8 Model Measurement Two Step become One Step

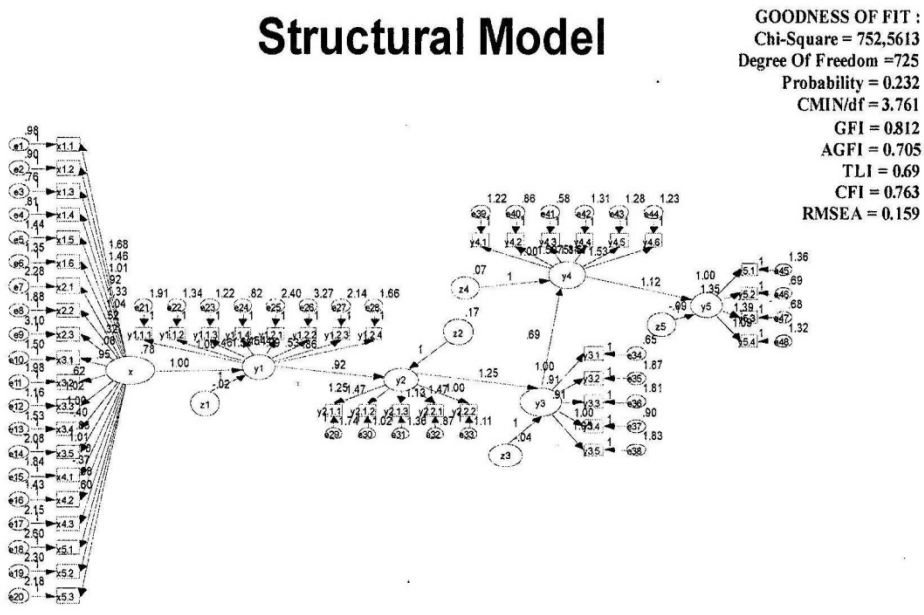

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Figure 9 Structural Model

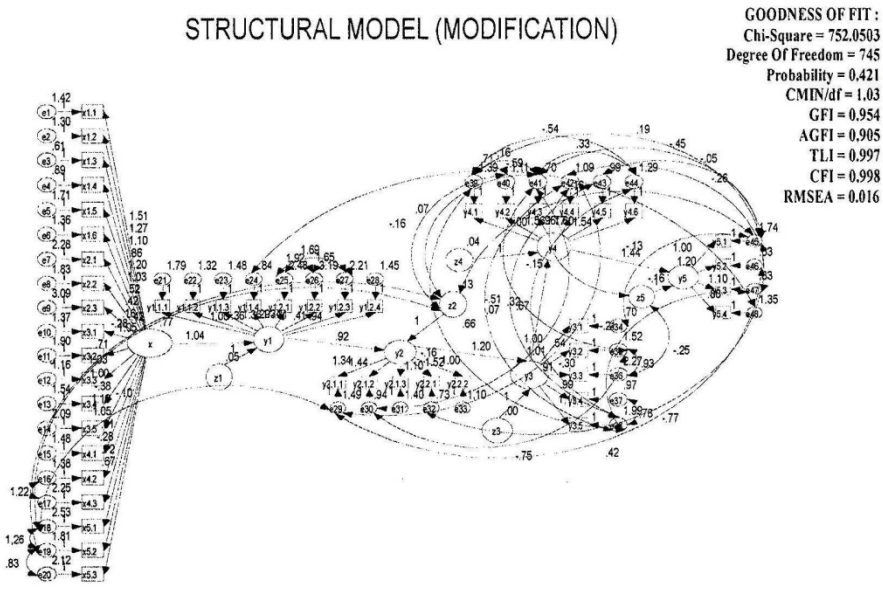

Figure 10 Model Two Step become One Step modified

DISCUSSION

For model one step (figure 4), the steps are equal to the two step model. But, for the two step model (figure 7) there is warning so that the model can not be estimated. Then, we can change model into one step (figure 8). Futhermore, the steps are equal to two step model above.

To use the SEM tool, processes should be done in 7 steps, but when the model is in good condition (Goodness of fit according to regulations), we do not need to modify it.

CONCLUSION

Multivariat analysis method using SEM tool can test model simultaneously that is relatively complex and unique. In the seventh steps of the SEM, we should not modify it when the model have been good condition (Goodnes value Of Fit). SEM tool have the ability to estimate model one step, two step, and two step into step one.

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